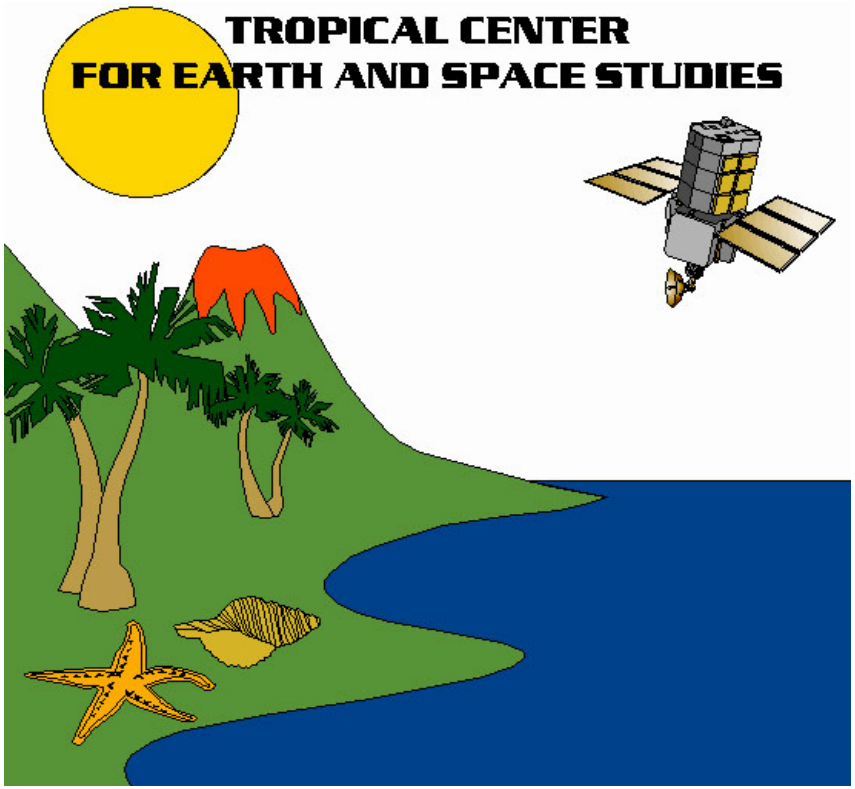

UPR – MAYAGUEZ GROUND STATION CAPABILITIES

Presented at the
EESS Wideband Downlink Workshop
Orlando, Florida
25-27 March 2003
by:

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UNIVERSITY OF PUERTO RICO
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Space Information Laboratory Provides Satellite Reception Capabilities

The Space Information Laboratory (SIL) of the NASA-funded Tropical Center for Earth and Space Studies aims to provide data from several orbiting satellites to the scientific community. Its facilities currently house a TeraScan HRPT reception system from SeaSpace, which schedules, acquires, and processes data from NOAA and NASA satellites. More than 700 GB of data from over 10,000 passes have been received and stored in digital tapes since the installation of the HRPT antenna in December of 1996. We have distributed satellite data to people with different interests in and outside of Puerto Rico. In addition, we recently installed an X-Band antenna that allows us to receive data from RADARSAT and LANDSAT-7, and the MODIS sensor aboard the Terra satellite. The location of these ground stations makes possible the acquisition of data from the Mid-Atlantic Ocean to the Gulf of Mexico and from Brazil to Northern United States. Satellite data collected at SIL is actually used by the Bio-Optical Oceanography Laboratory (BIOL) in different ways. NOAA-AVHRR data provide information of the Sea Surface Temperature and allow to track hurricanes in the region. Orbview-SeaWiFS data are used to study phytoplankton dynamics. Imagery from MODIS will further enhance these capabilities.

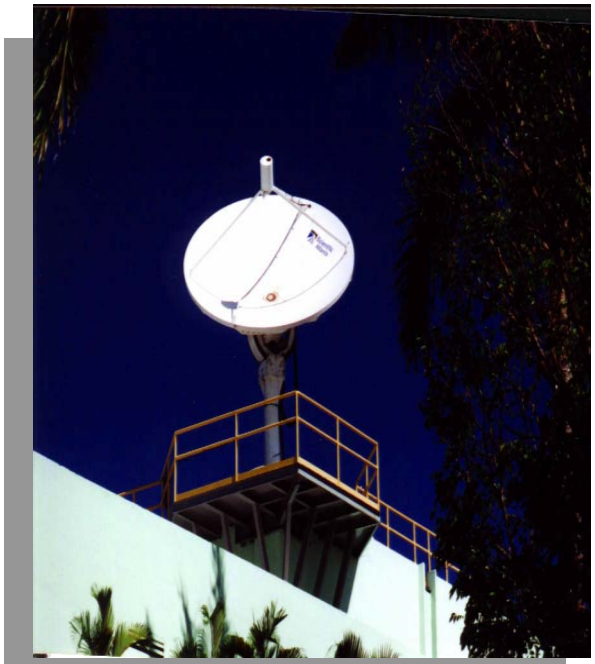
History

SIL Satellite Tracking Antennas

L-band

1.2 M

X-band



4.3 M

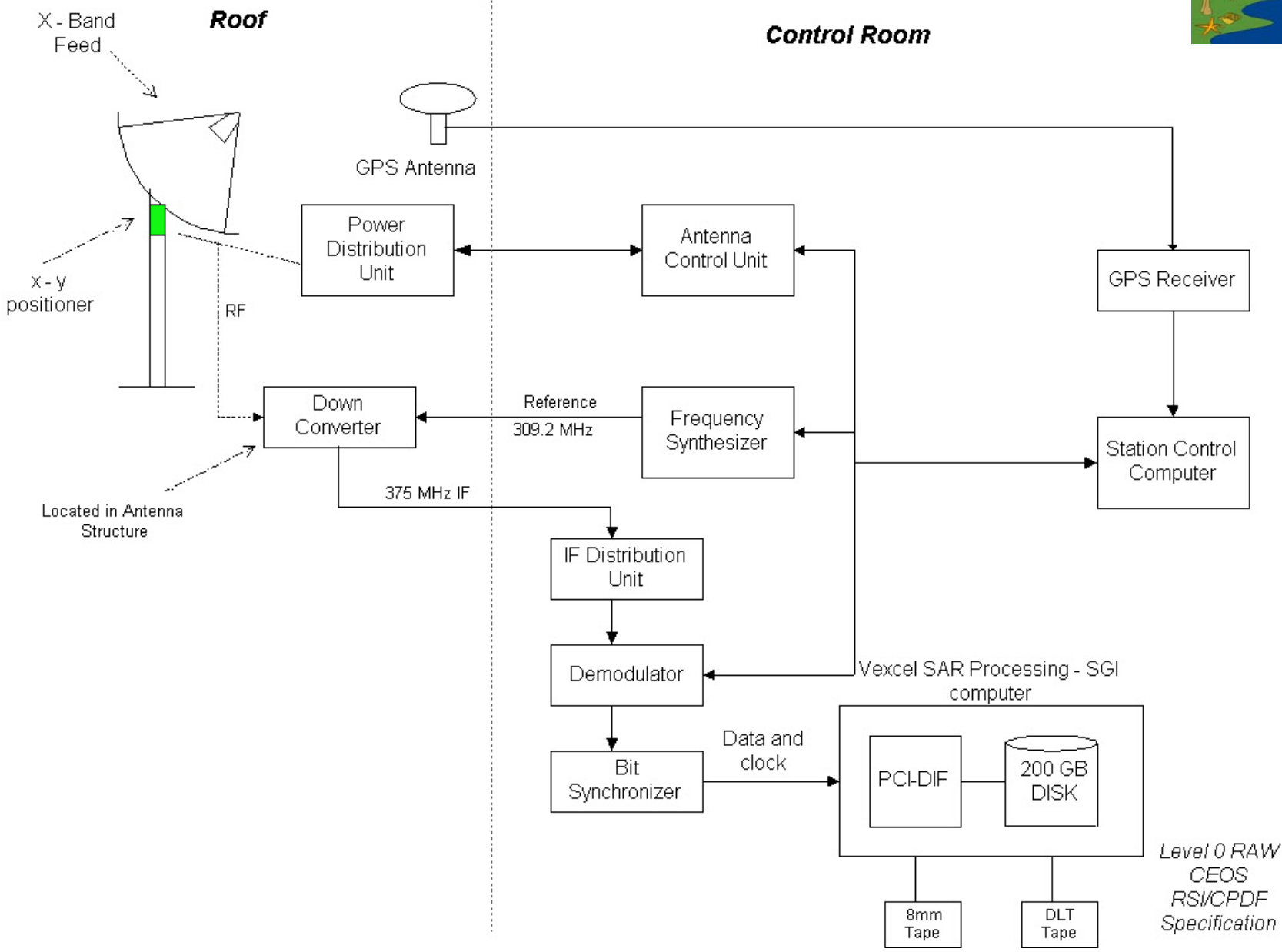
S-band

5 M

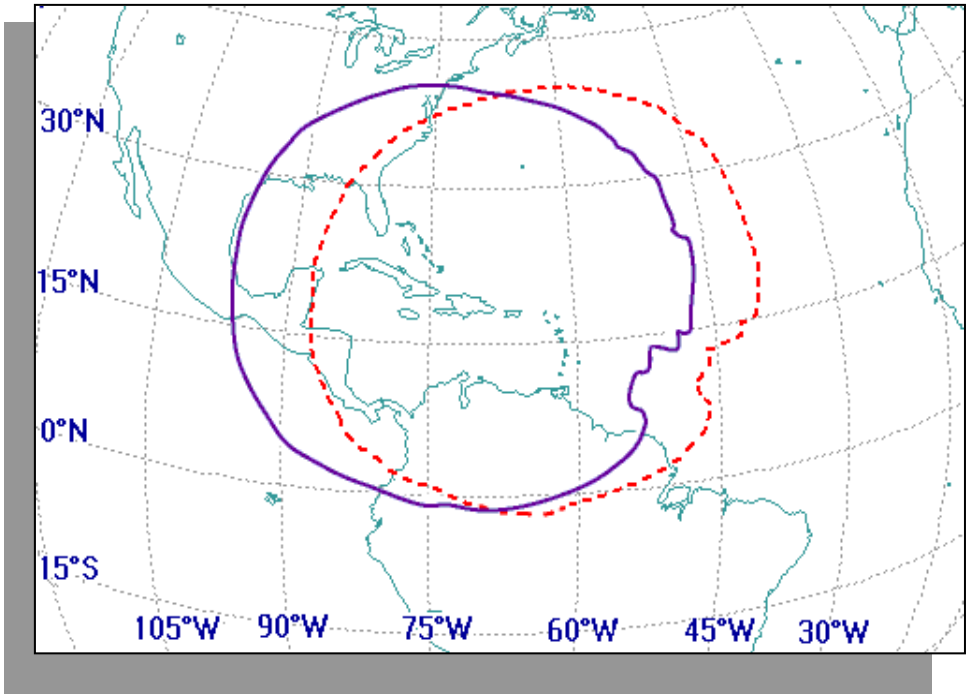
4.3m X-Y Mount Antenna

- X-Band Feed by ViaSat
  - G/T of 29.4dB/K (8.025GHz at 10° elevation)
  - Win NT-Pentium II Scheduling and antenna control system and X-windows S/W
- Vexcel Direct Capture System VxDCSTM
  - Consisting of PCI data capture card, Silicon Graphics Origin 200 Computer with fiber channel HD and DLT, 8-mm, DVD-RAM, CD-ROM archive devices

UPR - Mayaguez SAR Receiving Station



Station Viewing Area

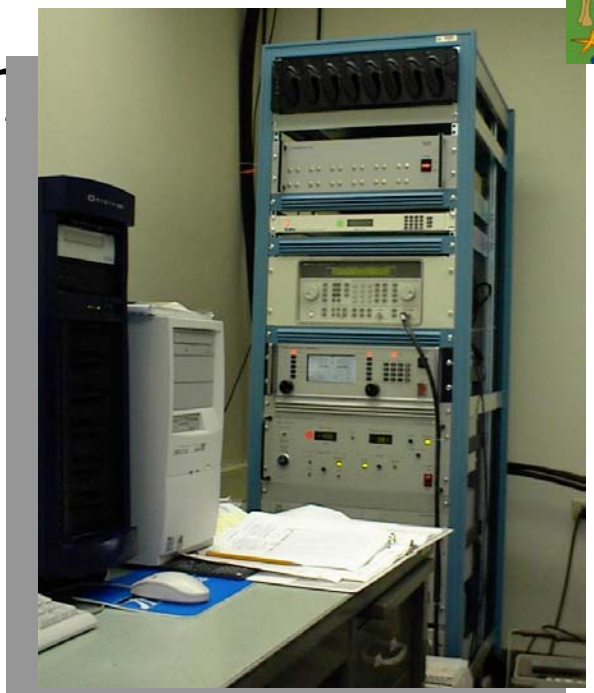


- Location
  - latitude: 18° 12.68' N
  - longitude: 67° 08.02' W
  - elevation: 45m AMSL
- Coverage area is for 5 degree horizon
- Coverage in the southern sector may be much better because of the unobstructed path

X-band Ground tation

Vidya, Fernando, and Javier
(left to right).

Pieter, Vidya, and Javier (front to back).

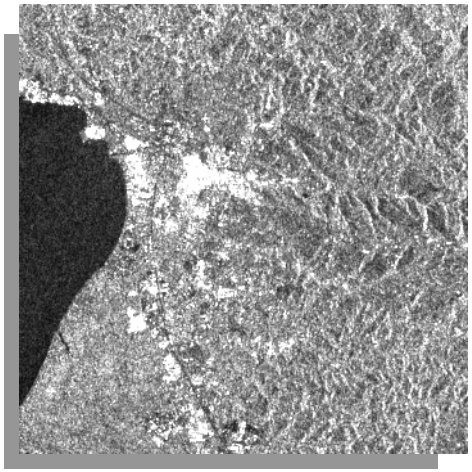


They are: SGI-200 –SARprocessor-, Pentium-II –SCC- and RF/DEM/Bsync system rack (left to right).

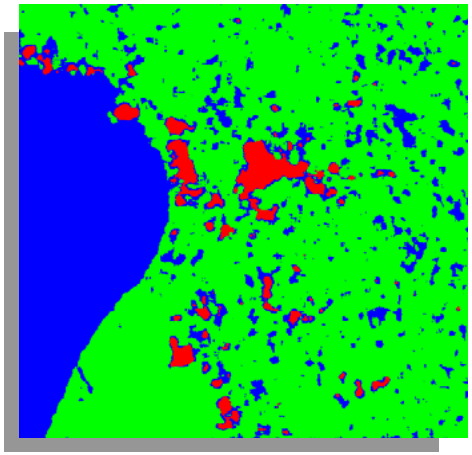
GS Staff:

1. Mr. Javier Díaz
2. Mr. Pieter van deer Mier
3. Mrs. Vidya Manian
4. Mr. Fernando Gilbes

Research at X-band Ground Station



Original SAR image of Mayagüez



Classified SAR image

Primary Image Products

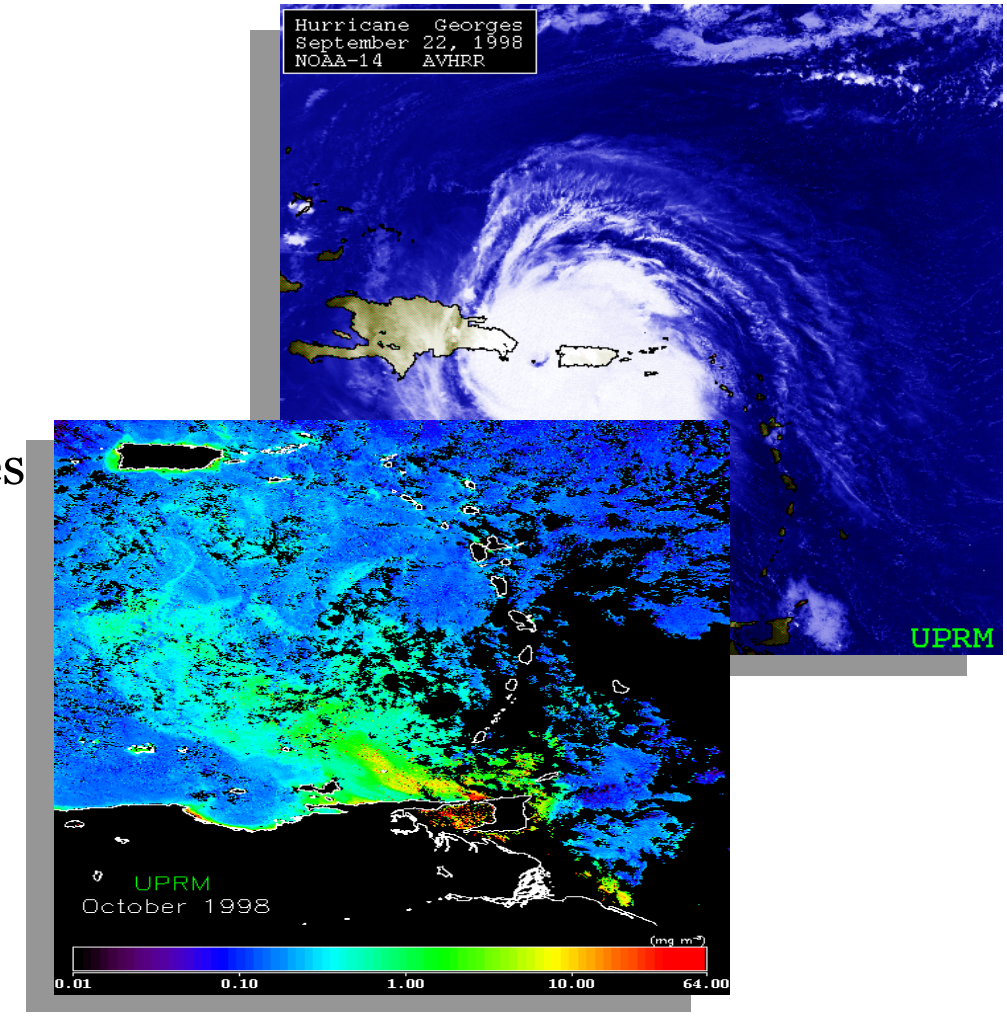
- RADARSAT - SAR Level 1 Image Products
- Landsat 7 - implementation of LPGS (Level 1 Product Generation System)

Application Specific Image Products

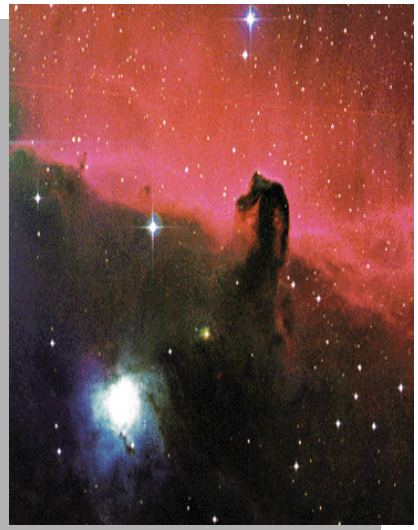
- Coastal studies
- Land use classification
- Ocean dynamics
- Oil Slick classification
- River plumes studies
- Copper deposits assessment

TeraScan Station

- HRPT RX station
  - 1KM Resolution
- NOAA 12/14
  - Polar Orbit Satellites
  - Weather
  - Temperature
- Orbview2 (SeaWiFs)
  - Ocean Color



FUSE Mission

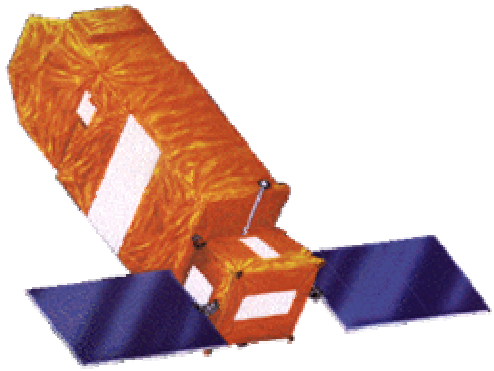


The beautiful Horsehead Nebula in Orion dramatically demonstrates the presence of gas and dust in the vast regions of space between the stars. (Image © Anglo-Australian Observatory.)

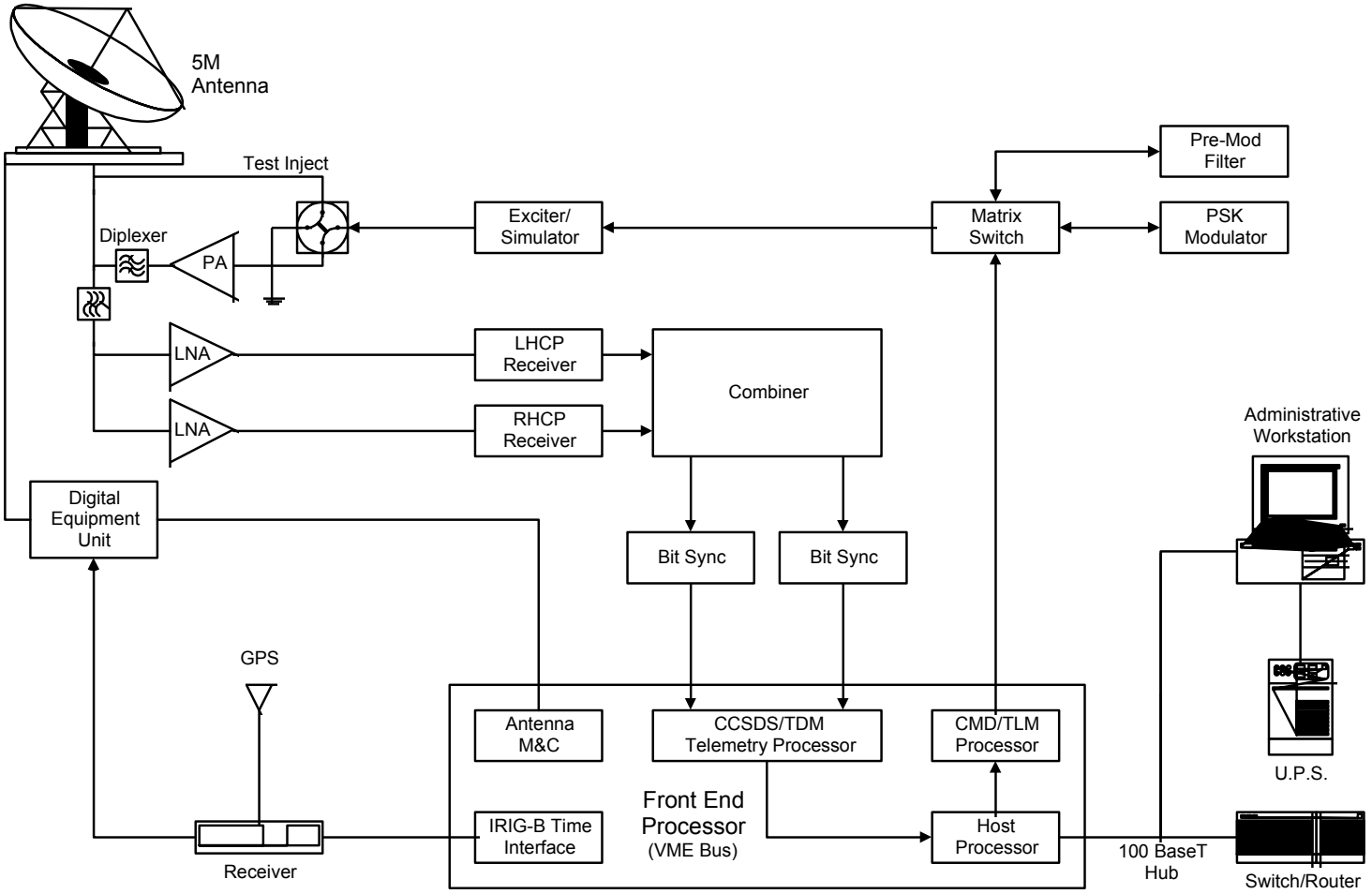
The operations center at JHU will "talk" to the FUSE satellite primarily through a single ground station located at the University of Puerto Rico in Mayaguez. About six to seven times each day, for about 10-12 minutes at a time, FUSE controllers will be able to send instructions up to the satellite and receive transmissions of its precious data back to the ground. The rest of the time, the satellite is "on its own", operating autonomously based on the commands that have been uplinked.

The FUSE antenna has a radome, and inside it a WebCam that tracks every movement of the antenna. JHU along a NASA donation provided a 125 KW backup generator to RDC, supplying a reliable power to the whole SIL.

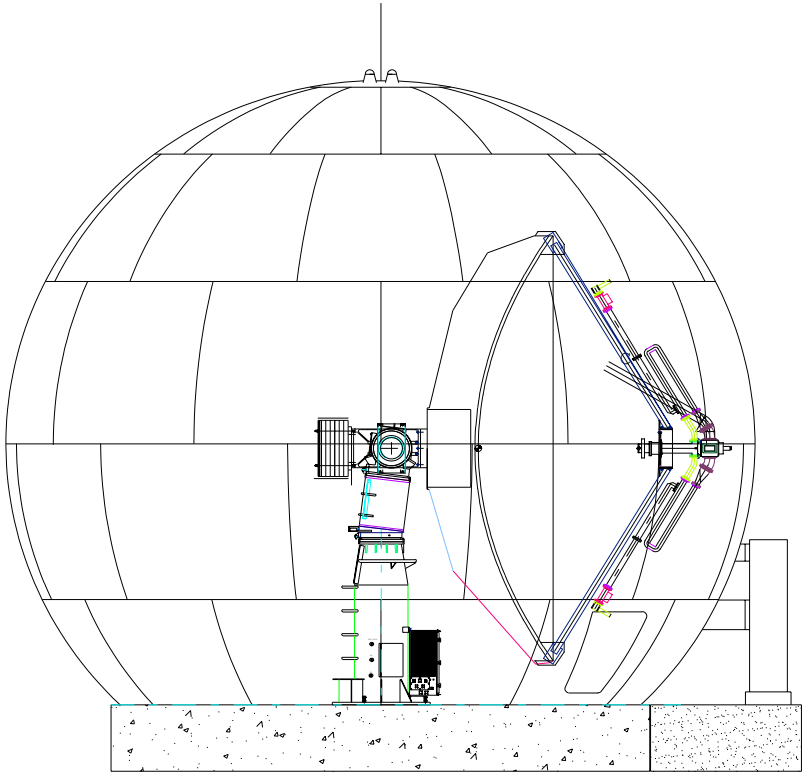
(http://136.145.160.44)



LEO-T Simplified Block Diagram



FUSE Capabilities



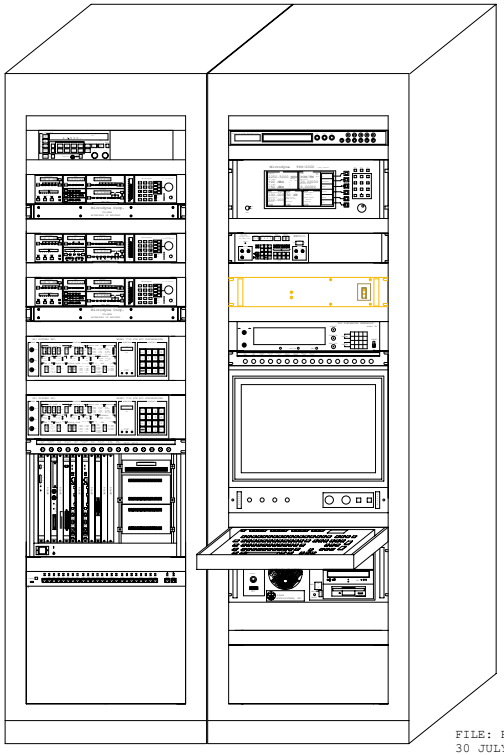


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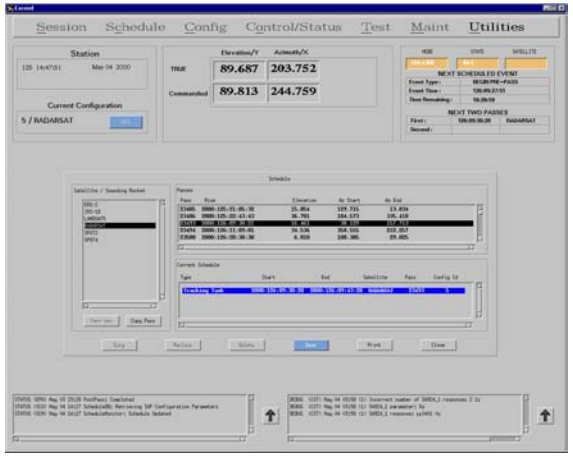
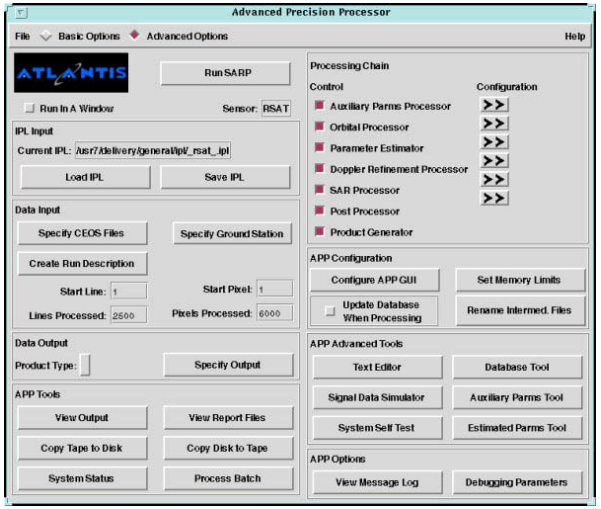
Table 1.6-1 LEO-T Performance Specifications	
Antenna Subsystem	
Gain	39.0 dBi at 2200 MHz (receive) 38 dBi at 2025 MHz (transmit)
FEED:	
Type	Scalar ring horn with OMT, diplexers, and waveguic switch for transmit polarization.
Frequency Range: Receive	2200-2300 MHZ
Polarization: Receive	Simultaneous RHCP and LHCP
REFLECTOR:	
Sidelobe Level	-15 dBp Maximum
Type	Parabolic, solid surface
Diameter	5 Meters
Antenna Positioner	
Peak velocity	
Azimuth	20°/sec Minimum
Elevation	20°/sec Minimum
Third Axis	10°/sec Minimum
Peak acceleration	
Azimuth	20°/sec/sec Minimum
Elevation	20°/sec/sec Minimum
Third Axis	20°/sec/sec Minimum
Azimuth axis tilt	7° cone from vertical
Travel Limits Note: Full hemispherical coverage down to -7° elevation is achievable by rotating the third axis. With the antenna positioned in the same direction as the third axis tilt the lowest elevation angle is -7°. Global coordinates refer to the horizon. Positioner coordinates are with respect to the positioner azimuth axis which is tilted 7° from the horizon.	**Elevation:** Global / Positioner Digital Prelimits: -7°, 95° 0°, 102° Electrical: -8°, 97° / -1°, 104° Mechanical: -9°, 175° / -2°, 182° **Azimuth:** Digital Prelimits: ±361 deg Electrical: ±362 deg **Third Axis:** Prelimits: ±181 deg Electrical: ±182 deg
Orthogonality error	0.02°, peak
Servo Subsystem	
Uplink Insertion Loss	2 dB Maximum
Uplink VSWR	1.5:1 Maximum
Power Handling Capacity	400 watts
Test Translator Conversion	Fixed LO 181.1 MHz
Diplexer	
Receive frequency range	2200 - 2300 MHz
Transmit frequency range	2025 - 2120 MHz
VSWR	1.15:1 max
In band insertion loss from common junction to outputs	0.5 dB max. @ 2200 - 2300 MHz 0.5 dB max 2025 - 2120 MHz
Transmit band rejection from transmit to receive port (2025-2120 MHz)	120 dB min
Power handling Transmit band (2025-2120 MHz)	200 Watts CW
RF Subsystem	
Receiver Lock Thresholds	FM: 9dB C/N in 2nd IF PM: -12dB C/N in 2nd IF, 6dB C/N in PLL BPSK: 0dB Eb/No in 2nd IF QPSK: 4dB Eb/No in 2nd IF
Receiver Acquisition time	2 seconds
Telemetry Rates	8 Mbits(symbols) NRZ-L
Implementation Loss	within 1.5 dB of theoretical (w/ equal power signa into receivers)
Viterbi Decoding	Rate 1/2, L7, G2 inversion
Diversity Combining	Polarization fade rates to 25 KHz
Autonomous Control and Processing Subsystem	
Front End Processor	
Telemetry Processing Modes	TDM, CCSDS Versions 1 and 2
Injest Rate	Up to 4 MBps (baseband), up to 256 Kbp (subcarrier)
Store and Process Rate	Up to 4 MBps
Data Storage	At least 72 hours
Output Rate	Up to 4 MBps
Simulator/Command Generator	1bps to 4 MBps selectable
Administrative Workstation	
CPU	Pentium 133 MHz
Memory	128 Mb ECC RAM
Disk Drives	2 2Gb hard drives 1 3.5 inch floppy
Media I/O	CD ROM
Communications Interface	100 BaseT Ethernet
I/O Ports	4 DB9 serial and 1 DB25 parallel
GPS receiver	

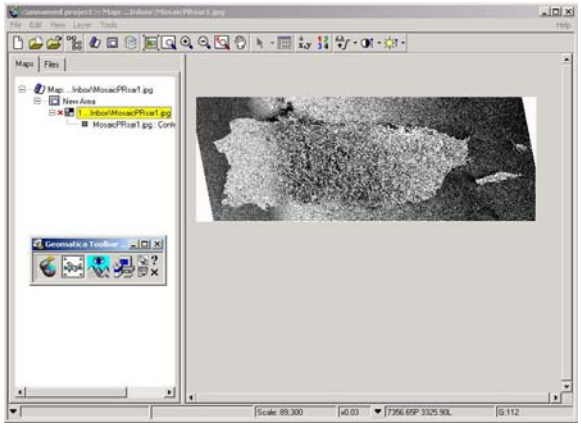
COTS Tools



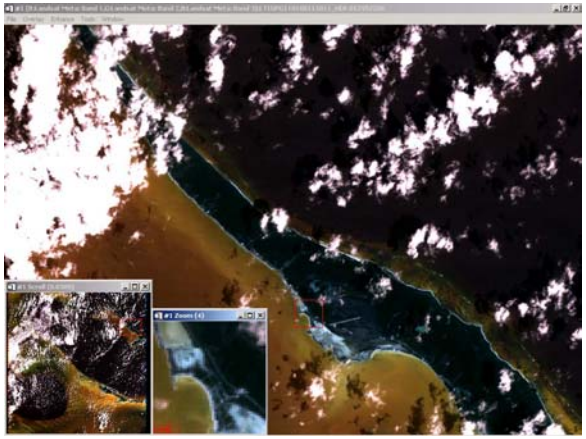
Station Control Computer



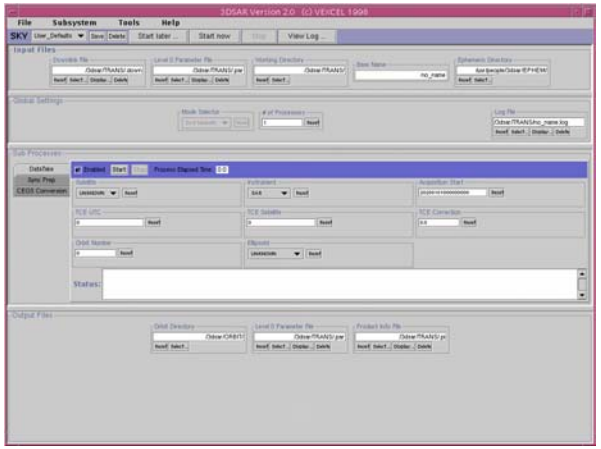
EarthViewTM APP Environment



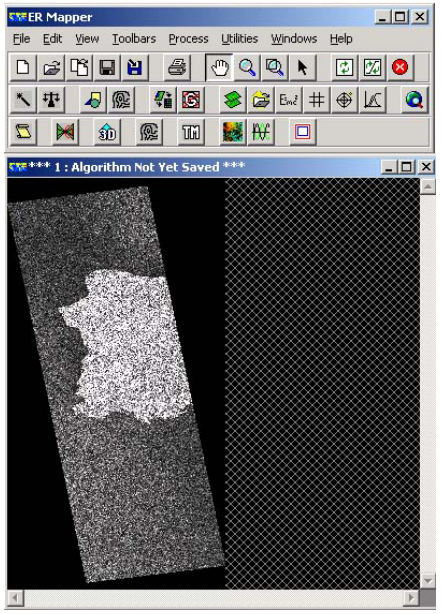
PCI Geomatica



ENVI

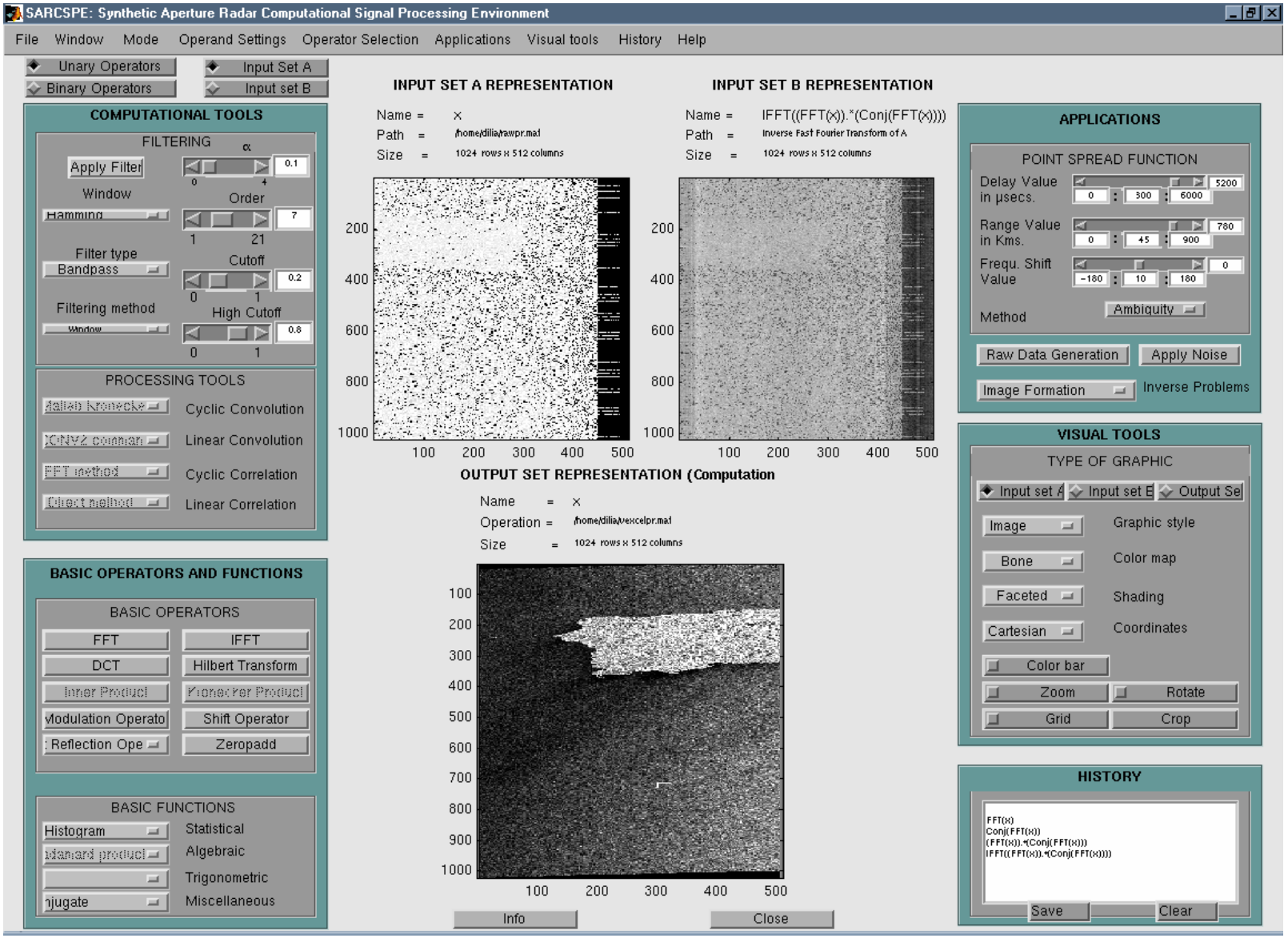


Vexcel VxDCSTM

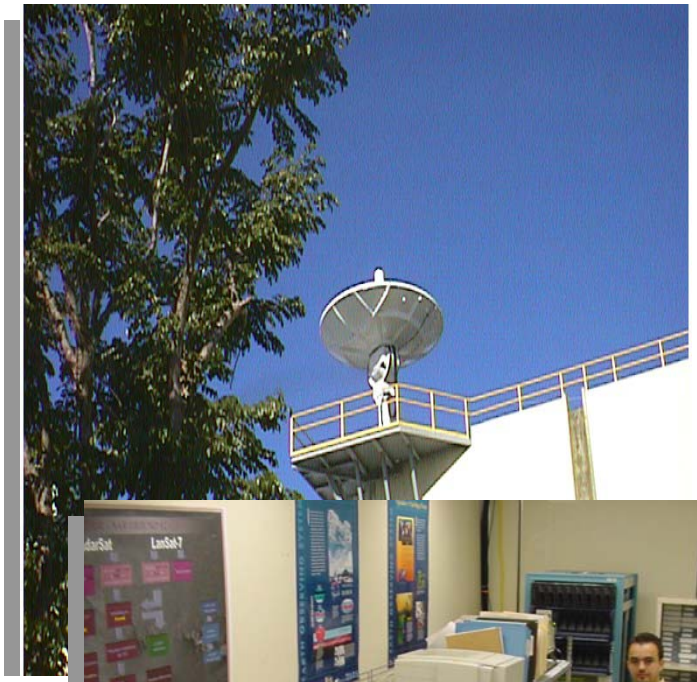


ER Mapper

Our Own Tools

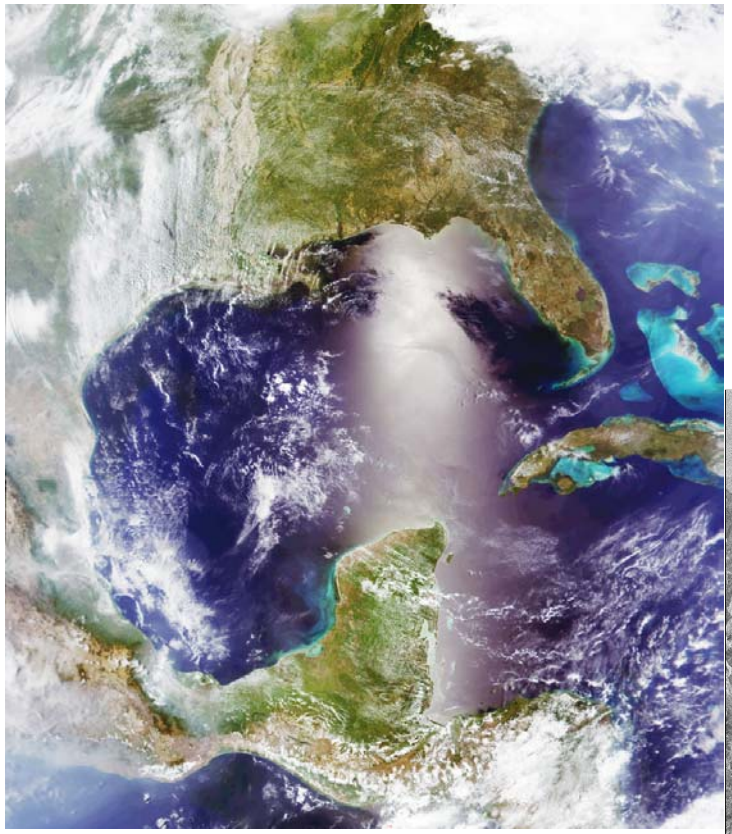


Research at SIL



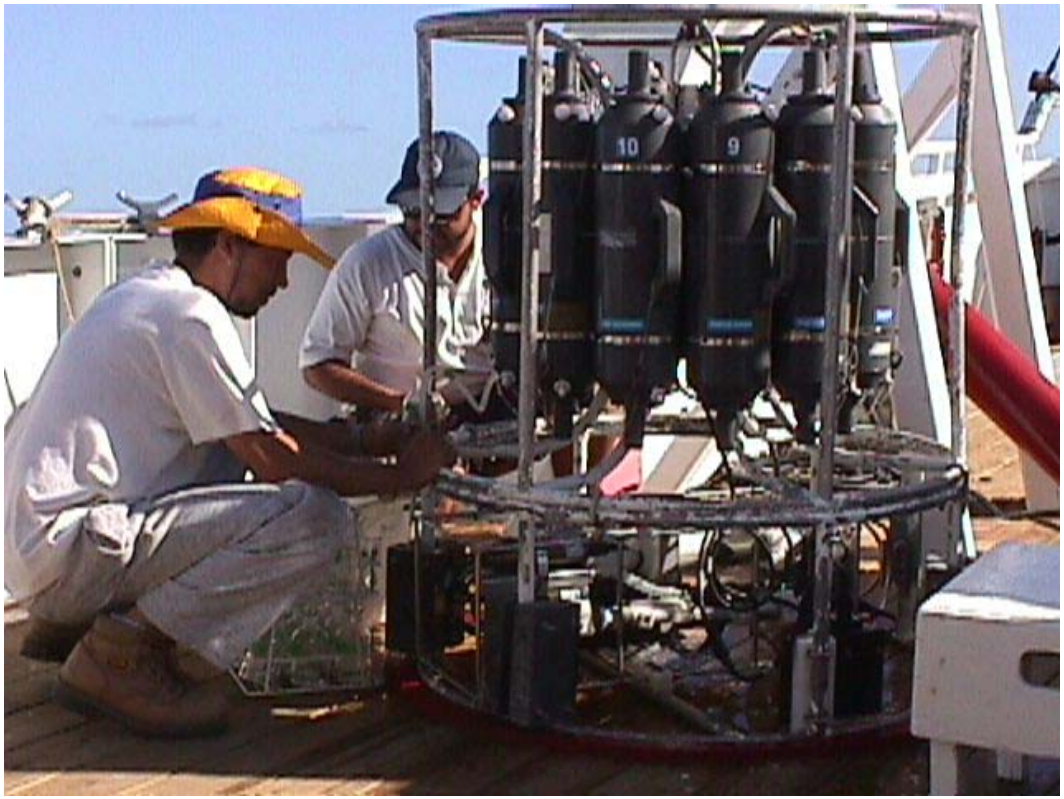
- Investigations focusing on multispectral determinations of biological productivity of the oceans coupled with sea surface temperature, and the movement of deep ocean currents, upwelling, etc. were presented. Satellite-based analyses were corroborated by in situ ocean measurement and floating laboratory analyses.
- In addition to this field effort, will be using LandSat 7 images for land classification within the watershed and areas that can be use for renovation using environmental cane. Comparison of LandSat 7 images in a time interval can give us a clue to the capacity of the watershed to export sediment into the water impoundments and the receiving Atlantic ocean.
- The remote sensing data then will serve as input to an algorithm that calculates aerosol optical depth.
- In the summer months, aeolian dust from the Sahara region could be an important, and yet unquantified source of nutrients. Coastal upwelling from the Colombian and Venezuelan coasts also provides nutrients to surface waters. The relative importance and magnitude of these and other nutrient sources need to be ascertained
- The estimation of primary production (and carbon budget) at regional and global scales is a major objective of NASA's Earth Science Enterprise. The extensive use of NASA's remote sensing technology by this program further justifies NASA's mission in education and research.

X-Band Ground Station Processes
LANDSAT 7, RADARSAT 1, & MODIS



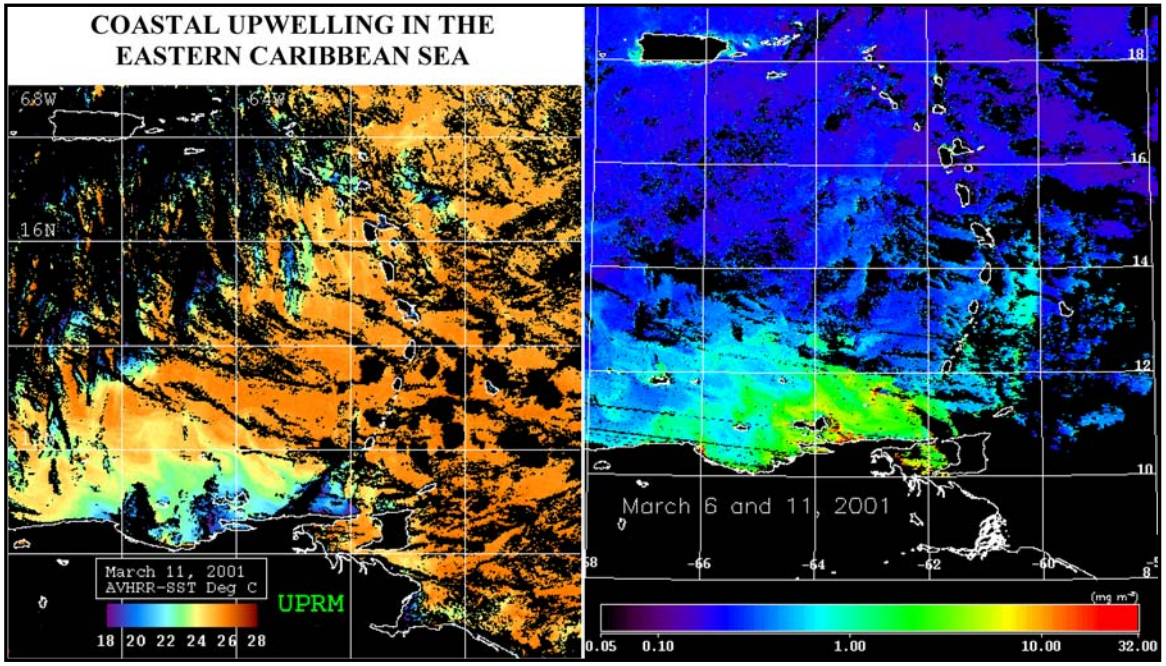
Bio-Optical Oceanography Component Characterize the Main Sources of Fertilization and Biological Productivity in the Region

Students prepare the instrument package for in situ profiling of the inherent optical properties (IOP) and apparent optical properties (AOP) of the water column.



Validation of Data

During the past several years, an important part of our research have been focused in the acquisition of field data for validation of bio-optical algorithms used in ocean color sensors, like SeaWiFS and MODIS. Fieldwork is carried out in oceanic and coastal waters using for the first time a bio-optical rosette (see photo). This optical rosette is used to measure the bio-optical properties down to 200 meters. Multi-year time series recorded at the Caribbean Time Series (CaTS) station depict seasonal variations in the optical properties of near-surface waters that are associated to seasonal events, like the intrusion of the Orinoco River during fall. Such variability is responsible for low accuracy in the estimation of phytoplankton Chlorophyll-a using the current bio-optical algorithms. Other seasonal events, like coastal upwelling in Venezuela during spring, are now the focus of our studies to determine their importance in the bio-optical properties of the region. Near real-time images of AVHRR and SeaWiFS are provided by SIL and used to delineate the field campaigns. That was the case during our last research cruise in March 2001. The images helped to better sample the very strong coastal upwelling during that time. Examples of these images are shown below.



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